NHB–3 Series Transceiver

Chapter 5

UIF MODULE GU8

CHAPTER 5 – UIF MODULE DU8

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Introduction

NOTE! UIM (User Identity Module) = SIM (Subscriber Identity Module)

DU8C UI–module ismade for HD851 project. It is used also in HD851EFR product. UI–module is based on GSM/PCN UI–module DU8. Two capacitors pads added for 18pF capacitors (2320041) from microphone pins to ground. Reason why capacitors are added is noise to microphone audio in certain situations. Also some changes are done for reability and productivity reasons. DU8C UI–module is for NOKIA1 design. Final product use only one 18pF capacitor between microphone pins.

Technical Outline

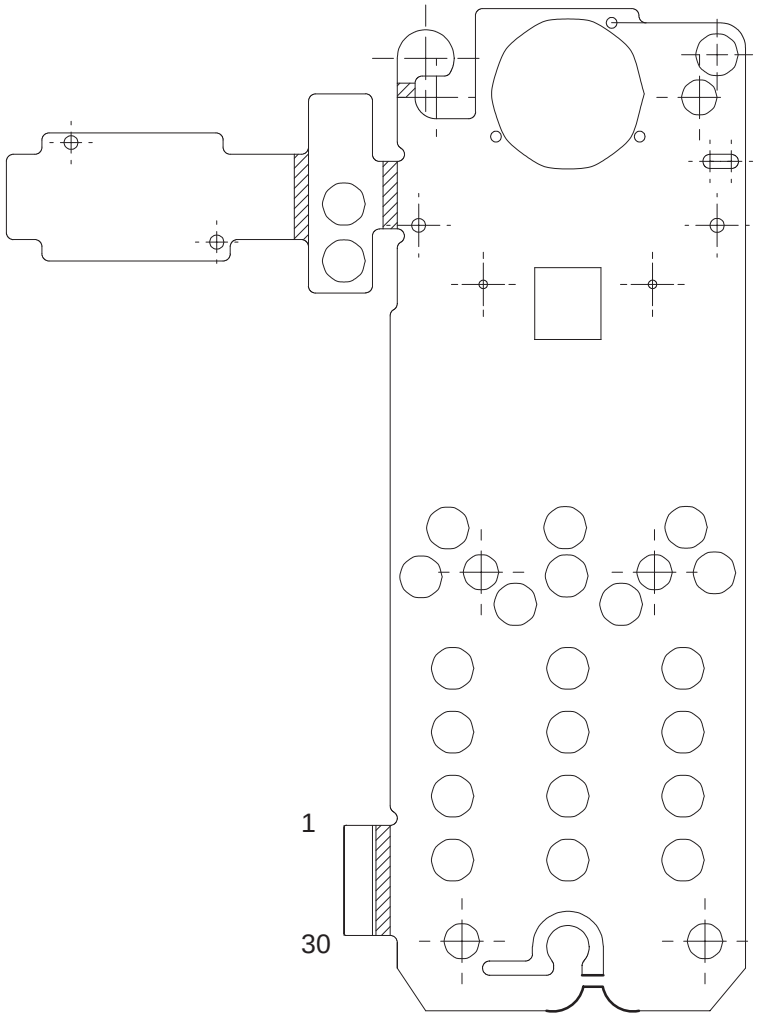
Mechanics

The module is made from a single flexible printed circuit board – loaded with all the parts for the User Interface Module. A flexible circuit was used for a number of reasons:

– The material is only 0.3 mm thick – so the phone's height buildup can be kept to a minimum.
– The Volume keys, SIM interface and microphone wiring can be folded to fit in the phone during assembly – since the circuit is flexible.
– Connection from the UIF to the main circuit board can be made with a folding termination.

The major mechanical parts on the UIF assembly include the following:

– Display Module:– LCD, Heat seal, LCD driver TAB circuit and Light guide.
– Main Keydome assembly: Adhesive film holding 20 metal dome clickers
– Volume & Power Keydome assemblies: Adhesive film (2 films for Style 1) holding 3 (2 + 1 for Style 1) domes for Vol Up, Vol Down & Power Key.
– Acoustic Components: microphone, speaker, buzzer.



DU8C Style Flexi

Figure 1. Flexi Outline

Electronics

The following sections of circuitry are on the flexi:

- Microphone Circuit
- Speaker Circuit
- LCD Display Module
- LCD voltage divider & temperature compensation circuit
- Keyboard & Display lighting circuits
- Keyboard switch matrix
- SIM Card Reader

List of Submodules and Mechanical Parts

Module	Submodule / Part	Material code	Notes
DU8C	Euro/USA Display Module	4850038	Common part
DU8C	Earphone Gasket	9450133	Common part
DU8C	Lightguide Assembly	9460074	Common part
DU8C	Mic Rubber	9460075	Common part
DU8C	Reflector	9480061	Common part
DU8C	Speaker Pad	9480062	Common part
DU8C	Buzzer Gasket	9480078	Common part
DU8C	Keydome Film Assembly	9795002	Main keyboard
DU8C	Keydome Film Assembly	9795004	Power key (up right corner)
DU8C	Keydome Film Assembly	9795006	Volume keys (side)

NOTE! All parts are common with DU8.

Technical Specifications

Maximum Ratings

DC Characteristics

Table 1. Supply Voltages and Power Consumption

Pin / Conn.	Line Symbol	Minimum	Typical / Nominal	Maximum	Unit / Notes
1 / X4	VL1	4.5	4.65	4.8	V
			1.5 mA		LCD material B
			0.8 mA		LCD material D (without temperature compensation)
24 / X4	VA1	4.5	4.65	4.8	V
			250 uA		mic enabled
			25 mA		max volume level to earphone
3, 30 / X4	VBATT	5.3	6.0	9.0	V
			85 mA	115 mA	Buzzer with max volume
			40 mA		Display illumination
			40 mA		Keyboard illumination

Control Signals

Table 2. Control Signals

Pin / Conn.	Line Symbol	Minimum	Typical / Nominal	Maximum	Unit / Notes
12 / X4	MIC_ENA Mic_Enable	–	0	3	Volts Mic Enabled
		VA1–0.4	VA1	VA1+3	Volts Mic Disabled
4 / X4	BACKLIGHT Key and LCD light	VA1–1.0	–	VA1	Volts Lights On
		0	–	2.0	Volts Lights Off
17 / X4	CALL_LED Call indicator	VA1–1.0	–	VA1	Volts LED On
		0	–	0.4	Volts LED Off
25 / X4	SIMCLK		3.25 /1.625		MHz
26 / X4	SIMRESET	–0.3		0.6	V Low level
		4.0		5.0	V High level
27 / X4	VSIM	4.5	4.65	5.5	V
28 / X4	SIMDATA			0.4	V Low level
		3.8	4.65		V High level

AC Characteristics

Table 3. Audio Specifications

HPMIC 1 kHz rms		NOTES
MRP pressure	2.8 dBPa	5 cm from MIC
MIC pressure	–2.2 dBPa	about 5 dB attenuation
MIC output	4.9 mV	mic sensitivity –64 dB 0 dB = 1V/uBar 1uBar=0.1Pa
Codec gain	35 dB / 275 mV	Codec maximum gain
Level	– 8.5 dBmO	0 dBmO = 739 mV

HPEAR 1 kHz rms		
Level	– 6 dBmO / 245 mV	0 dBmO = 490 mV
Codec gain	–3 dB	9 dB fixed gain – 12 dB atten.
Codec output	175 mV	max. volume 435 mV (+12 dB)
Earpiece pressure	9 dBPa	

Table 4. Other AC Specifications

BUZZER 2.7kHz	Minimum	Typical/Nominal	Maximum	NOTES
Buzzer		90 dB (S.P.L.)		Level measured 30 cm from the buzzer with pulse ratio 50/50

External Signals and Connections

Table 5. To Radio Module

Signal Name	Pin / Conn.	Notes
VL1	1	Logic supply voltage 4.65V
GND	2	Ground
VBATT	3, 30	Battery voltage
BACKLIGHT	4	Backlights on/off
UIF(0:6)	5 – 11	Lines for keyboard read and LCD–controller control
MIC_ENA	12	Microphone bias enable
COL(0:3)	13 – 16	Lines for keyboard write
CALL_LED	17	Call led enable
MICP	18	Microphone (positive node)
MICN	19	Microphone (negative node)
EARP	20	Earpiece (negative node)
EARN	21	Earpiece (positive node)
BUZZER	22	PWM signal buzzer control
XPWRON	23	Power key (active low)
VA1	24	Analog supply voltage 4.65V
SIMCLK	25	3.25 MHz Clock for SIM data
SIMRESET	26	Reset for SIM
VSIM	27	SIM voltage supply
SIMDATA	28	Serial data for SIM
AGND	29	Analog ground for the microphone

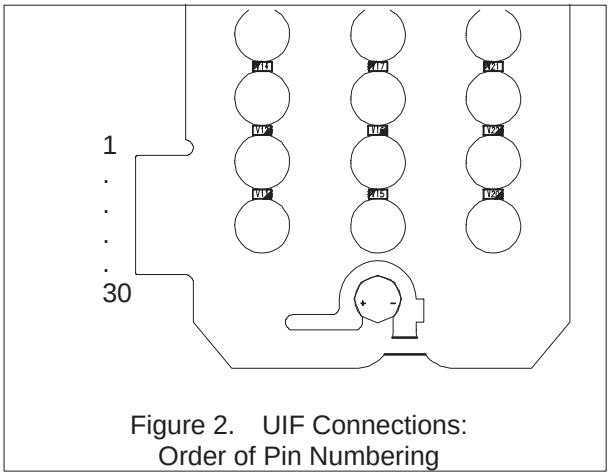


Figure 2. UIF Connections:
Order of Pin Numbering

Table 6. To LCD Module

Pin	Signal Name	Notes
1	GND	Ground
2,3	OSC1, OSC2	Oscillation terminals
4–8	V1–V5	LCD driving power source
9	V5OUT	Negative voltage converter output
10–11	C1, C2	4.7 uF capacitor to generate negative voltage for the input voltage VCI
12	VCI	Power source for voltage converter
13	VCC	Power source
14	RS	Register selection
15	R/W	Read/write
16	EN	Enable for read/write signal
17–20	D(0–3)	Lower bits of 8 bit data bus, not used
21–24	D(4–7)	3–state 4 bit data bus D7 also used for busy flag reading

Table 7. List of Connectors

Connector Name	Code	Notes	Specifications / Ratings
X1 Display Module Connection.	–	FCB footprint for Display Module	Refer to mentor footprint / Display Module Prodoc for pinout
X4 UIF Connector	–	FCB edge connector as described above.	30 connections at 0.5 mm pitch

Mechanical Characteristics

Table 8. Mechanical Characteristics

Module Name	Dimensions (mm) (W x H x D)	Weight (g)		
Bare Flexi circuit	50 x 141 x 0.3mm except in areas with partial thinning or thickening. (refer to mechanical drawings for more detail.	5		
DU8C module	<3.6 deep at LCD <4.2 deep at earpiece <6.3 deep at buzzer	22		

Functional Description

Circuit Description

DU8C Circuit Description

The module is connected with 30 pin flex connector to the system board, 24 pin connector to the LCD module and 6 pin connector to the SIM card.

The module includes following main blocks:

– keyboard

– SIM interface

– illumination

– audio block

– LCD Module interface

Keyboard scanning and display driver control

COL(0–3) are used as column lines in keyboard. UIF(0–5) are used as row lines. They are also multiplexed with display driver control signals.

When a key is pressed the ASIC gets an interrupt from a row and the MCU starts scanning. One column at a time is written to low and rows are used to read which key it was. The power off detection is multiplexed with one row; when all keys on the row seems to be pressed the ASIC knows that power key is pressed. The power key is also connected to PSL+ to switch the power on.

Row lines and UIF6 are used for display driver control. UIF(0–3) are used as 4 bit parallel data bus for the driver. UIF4 is used as read/write strobe, UIF5 to select data or instruction register and UIF6 as enable strobe.

Keyboard and display illumination

The keyboard illumination is achieved by using two transistors wired as simple constant current sinks. Each transistor supplies eight leds. The bases of the

transistors are all wired together and supplied by emitter follower V40. The led current is fixed by the values of R44 and R45 and the ratio of R51 to R52. The current is about 5 mA/ each LED. Note that on DU9 flexis, the 17th led is driven from an additional transistor.

The display illumination operates in a similar way to the keyboard drivers, two transistors are used to drive eight leds. The current in this case is defined by the value of R46, R47 and the ratio of R51 to R52. It is about 10 mA / each LED.

The Call LED is fed from a simple emitter follower.

Audio Circuitry

The earpiece is routed directly via series resistors to connector X4. The earpiece is dynamic type. The impedance is 32 ohm and sensitivity 118 dB / 1 V.

Microphone is of the electret type and needs a voltage supply for operation. When MIC_ENA is low bias voltage is connected to the microphone via transistor V8. V2 is wired as a switch for VA1, controlled by the microphone enable line [MICENA]. VA1 is an analogue rail supplied by the PSL+ chip on the system board. It is 4.65V in magnitude. The sensitivity of the microphone is –62 dB (0 dB = 1V/ubar). C26 and C27 in the MIC nodes act as high pass filter with pulldown resistors on the baseband side.–3dB point is about 100Hz.

The buzzer is dynamic one and the impedance is 25 ohm. Buzzer is driven from a two transistor switch which acts as a buffer for a CMOS output signal applied at BUZZER. The ringing volume is controlled by pulse width modulation.The diode V37 prevents damage to the transistor when switched off, absorbing the stored energy in the buzzer inductance and suppressing large positive going spikes on the transistor collectors.

Small value capacitors are fitted at critical points in the circuit to avoid problems with RF interference. One is placed directly across the microphone (C15). V9 has a cap to ground from each of its three terminals (C14, C17 and C21). There is also capasitors in earphone nodes.

LCD Module Interface

The LCD module includes the LCD and the display driver. The driver TAB is connected with heat seal connection to the LCD. The LCD is FSTN type. The duty ratio is 1/32 and the bias ratio 1/6.7. Viewing direction is 6 o‘clock.
The display driver is NJU6406–02 from JRC. It has internal clock oscillator and negative voltage generator. It has 9600 bit character generator ROM and 64 * 8 bits character generator RAM. The dispaly module is connected to the UIF module with 24 pin soldered connection.

The display module contains an oscillator to generate a negative voltage required for operation. The oscillator frequency is fixed on the UIF module by the resistance from pins 2 to 3 of X1, with the values of R6 and R16 shown, the frequency is within 180 kHz to 370 kHz. The negative going pulses appear at pin 9 of X1 where they are smoothed by C1 to give a voltage which is nominally equal but opposite to VL1.

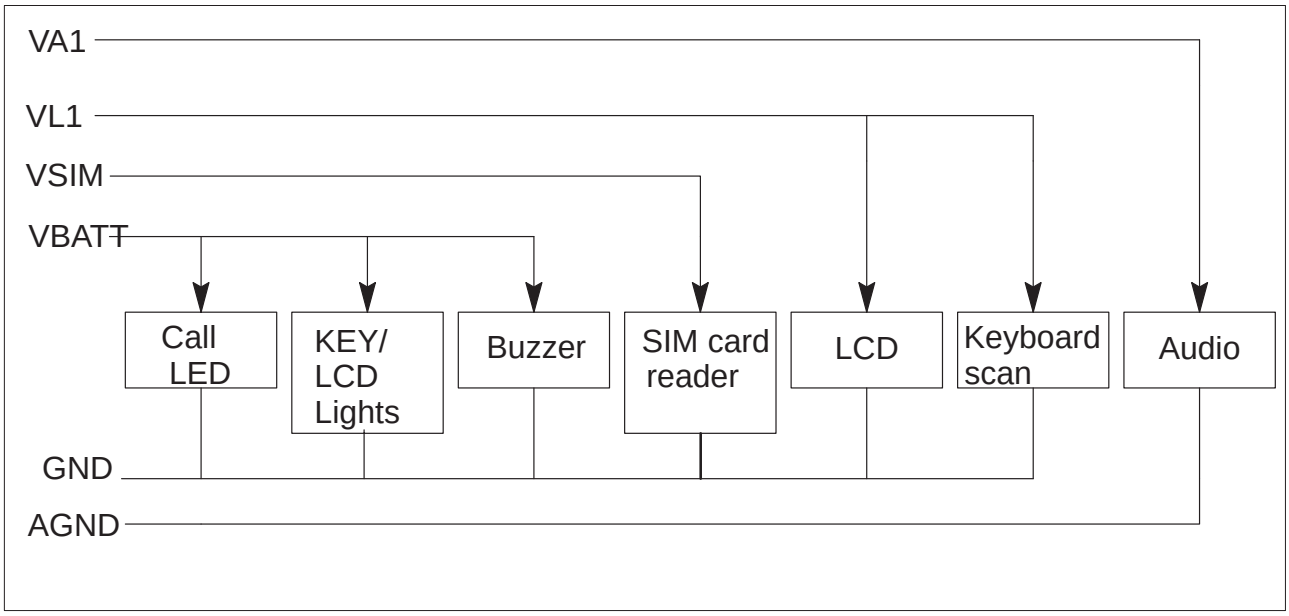
For correct operation of the display, dc voltages between –VL1 and VL1 need to be generated and fed back to the driver chip, at pins 4 to 8 inclusive (of X1). The exact voltages depend on the relative values of the resistors R21, R37, R38, R39, R40 and R33.

The display driver is connected to the radio module with a 4 bit data bus. Data transfer is controlled with the following signals: R/W selects read or write operation (”0” = write, ”1” = read), Enable activates read/write operations and RS selects the register (”0” : instruction register (writing) or busy flag (reading), ”1” : data register).

SIM interface

The SIM interface is the electrical interface between the smart card used in the GSM and PCN applications and the MCU via the ASIC. Four signals are used between the SIM card and the ASIC: SIMDATA, SIMCLK, SIMRESET and VSIM. Serial data is transferred between the card and the ASIC, the clock frequency is 3.25 MHz. When there is no data transfer between the SIM card and the HP the clock can be reduced to 1.625 MHz. Some cards allow to stop the clock in that mode. The ASIC also generates the reset for the card and the supply voltage VSIM.

Power Distribution Diagram



Assembly

Construction

The assembly drawings show the physical positioning of all the components on the flexis.

The preassembled parts are the Display Module (LCD + TAB + Heatseal), Key-Dome assemblies (Adhesive Film + Domes) and Lightguide/Reflector assembly

The basic assembly process is as follows:

– All SMD components placed & soldered.
– KeyDome assemblies fitted by hand (alignment jig recommended) (3 assemblies in DU8)
– Buzzer soldered manually
– Microphone soldered manually
– Speaker wires soldered manually
– Speaker attached to flexi with speaker pad
– Speaker gasket attached to top of speaker (self–adhesive)
– Display Module soldered to flexi (alignment pins required)
– Light guide/reflector assembly stuck onto the flexi over the TAB package
– LCD folded on to the top of the light guide and stuck down
– Functional tests performed.

Limited Bending Capability: The flexible circuits are constructed from a lamination of three layers of polyimide and two layers of copper tracks. The polyimide has almost unlimited bending capability – but the copper tracks cannot be bent to tight radii very often. At all times before the flexi circuit is installed into a phone, bending of the circuit should be avoided if possible. If the flexi circuit has already been installed into the phone, then care should be taken not to continuously fold the flexi circuit out flat and then back to its resting position too often.

Table 9. References to Other Construction Documents

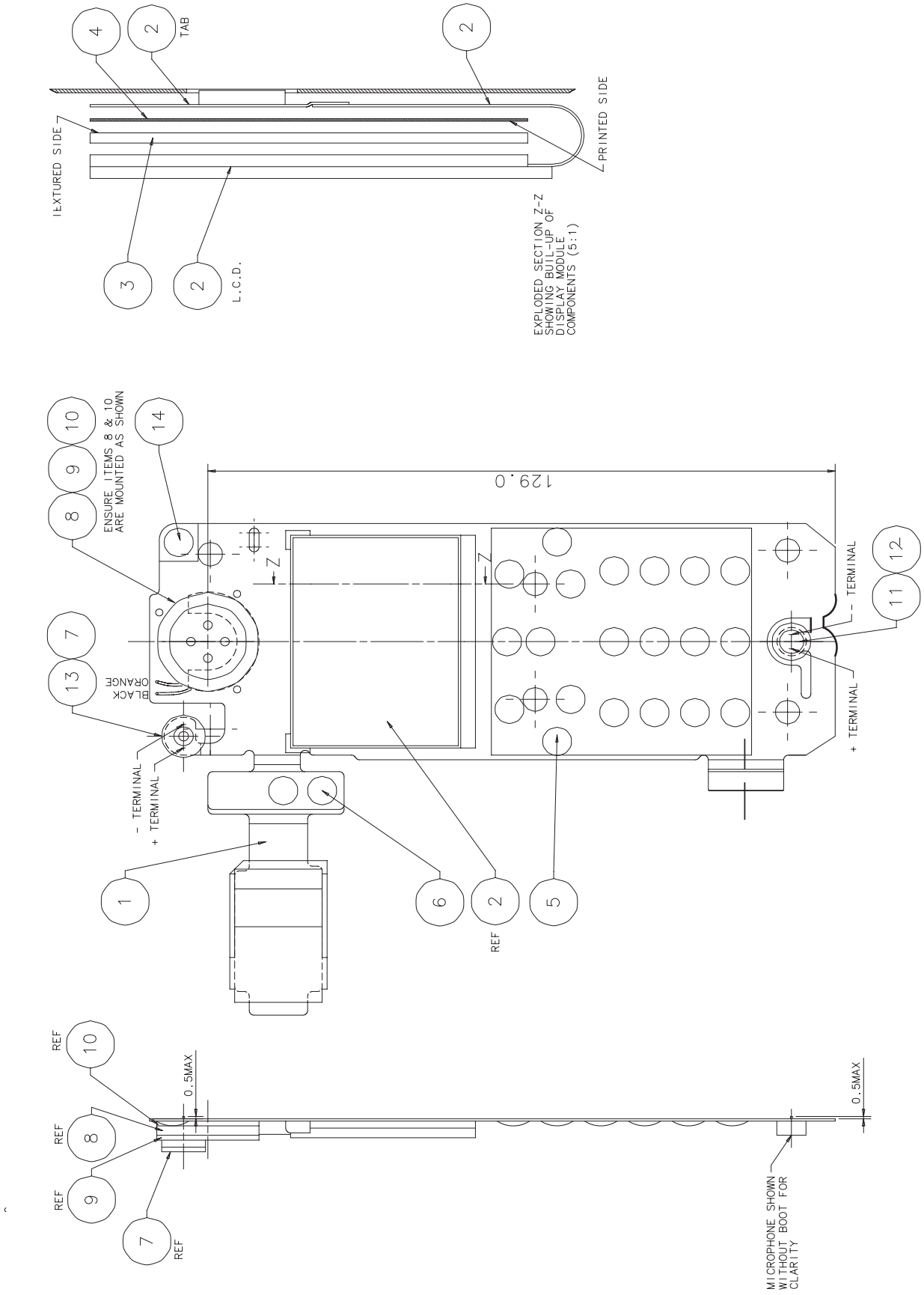
Document	Code	Sheets	Notes
Flexi outline	2D22779	1	Mechanical Outline Drawing

Assembly Description

Table 10. References to Other Assembly Documents

Document	Drawing n:o	Sheets	Notes
Flexi assembly for DU8C	2C23369	1	Common with DU8 Assembly Drawing

Flexi Assembly for UIF Module DU8



Assembly Parts of UIF Module DU8

ITEM	Q'TY	CODE	DESCRIPTION	VALUE, TYPE
1	1	9855011	F.P.C	
2	1	4850038	Display Module	
3	1	9460074	Lightguide	
4	1	9480061	Reflect	
5	1	9795002	Keydome Film	
6	1	9795006	Keydome Side	
7	1	9480078	Buzzer Gasket	
8	1	514H001	Earpiece	
9	1	9450133	Speaker Gasket	
10	1	9480062	Speaker Pad	
11	1	9460075	Microphone Rubber	
12	1	514H002	Microphone	
13	1	514H003	Buzzer	
14	1	9795004	Keydome Pwr	

Testing

Recommended Test Equipment

Radio Modules db1 and db6.

Test Procedure

1. Connect the UIF module to the radio module and place a SIM card to the card reader of the flex.
2. Connect a battery to the battery connector.
3. Switch the power on and check that all the segments of the LCD are displayed.
4. Verify that all keyboard and LCD backlight leds are illuminated.
5. Verify that the SIM card is accepted.
6. Press all keys and verify that all keypresses can be detected.
7. Verify that the earpiece is generating a tone during a keypress.
8. Make a call to the tranceiver.
9. Verify that the ringing tones are coming from the buzzer.
10. Verify that the call led is illuminated.
11. Answer the call.
12. Verify that the microphone is working.